density determinations contained in this paper, and more especially in those "On some of the products of the Destructive Distillation of Boghead Coal," the author has so repeatedly had to ascertain the value of the expression $\frac{1}{1+0{\cdot}00367\,T}$, that he was induced to calculate it once for all for each degree of the Centigrade thermometer from 1° to 150°. As it is always easy so to manipulate as to prevent the value of T falling between the whole numbers, the Table proved a most valuable means of saving time; the author has therefore appended it to his paper in the hope of its proving equally useful to other working chemists.

V. "On the Thermal Effects of Fluids in Motion—Temperature of Bodies moving in Air." By J. P. Joule, LL.D., F.R.S., and Professor W. Thomson, LL.D., F.R.S. Received June 21, 1860.

(Abstract.)

An abstract of a great part of the present paper has appeared in the 'Proceedings,' vol. viii. p. 556. To the experiments then adduced a large number have since been added, which have been made by whirling thermometers and thermo-electric junctions in the air. The result shows that at high velocities the thermal effect is proportional to the square of the velocity, the rise of temperature of the whirled body being evidently that due to the communication of the velocity to a constantly renewed film of air. With very small velocities of bodies of large surface, the thermal effect was very greatly increased by that kind of fluid friction the effect of which on the motion of pendulums has been investigated by Professor Stokes.

VI. "On the Distribution of Nerves to the Elementary Fibres of Striped Muscle." By Lionel S. Beale, M.B., F.R.S., Professor of Physiology and of General and Morbid Anatomy in King's College, London, and Physician to King's College Hospital. Received June 19, 1860.

(Abstract.)

After alluding to the general opinions entertained with respect to

the termination of nerve-fibres in voluntary muscle, and to Kühne's recent observations, the author proceeds to state that his researches have led him to the conclusion that every elementary fibre is abundantly supplied with nerves, which form a network and lie upon the surface of the sarcolemma. They do not penetrate through this membrane. The nerves never terminate in points, neither can any elementary fibres, or any part of a muscle, be found to which nerves are not freely distributed.

The nerves run for the most part with the smaller arteries, and come into very close relation with the capillary vessels. The elementary fibres of the tongue and diaphragm of the white mouse are nearly covered with nerve-fibres and capillaries. Generally, the muscular fibres of mammalia and birds receive a much larger supply than those of reptiles and fishes. The muscular fibres of some insects appear to receive a most abundant supply.

As the nerve-trunks approach their distribution the individual fibres divide and subdivide, as was demonstrated long ago by Wagner. The fibres resulting from the subdivision often pursue a very long and complicated course by running parallel with other fibres derived from different trunks, until, after being traced for some distance, it is not possible to follow them. Fine trunks composed of from three to seven or eight fibres can often be seen traversing the muscle. The fibres pursue different directions; some dip down between the elementary muscular fibres, some pass and form with others from a different source small compound trunks, while others may be traced onwards for some distance; the individual fibres which gradually separate from each other being distributed to different parts, in succession, of several elementary muscular fibres. When the finest nerve-fibres can be seen passing round the elementary muscular fibre, they clearly consist of very delicate flattened bands.

Of the oval bodies or nuclei.—Connected with all nerves in every part of the body, sensitive, motor, vascular, and probably in all animals, are little oval bodies or nuclei, which are the organs by which the nerves are brought into the closest relation with other textures. The nerves multiply at their distribution by the division of these little bodies, and upon them their nutrition and the manifestation of the nervous phenomena depend. A great number is associated with perfection of nervous actions, and *vice versâ*. They are found very freely connected with the vascular nerves, are abun-

dant on those nerves near the ganglia from which they proceed, and in the ganglia themselves. These bodies, with the nuclei of capillary vessels and those of fat vesicles, and probably other structures with peculiar cells, which alone deserve the name, have been included under the term "areolar tissue corpuscles" (*Bindegewebekörperchen*). As specimens are usually prepared, it is quite impossible to distinguish these structures from each other. It is probable that the gelatinous fibres, or fibres of Remak, are after all real nerve-fibres, and not a peculiar modification of fibrous tissue, as is now generally believed.

The nerves and vessels, and with them, of course, the oval bodies, may be stripped off from the elementary muscular fibre. They are in close contact with the sarcolemma; and the author has been led to conclude from some appearances he has observed, that this structure is really composed of capillaries and nerve-fibres, with intervening tissue.

Of the manner in which nerves terminate.—The fibres connecting the oval bodies or nuclei form with them a network, the branches of which are of course continuous with the subdivisions of the nerve-fibres. The arrangement of the network, and especially the number and proximity of the nuclei to each other, differ materially in different localities. On sentient surfaces the meshes are very small and the nuclei close together; but from the complexity and great number of the fibres, from the fact that many fibres which appear to be single can be resolved into three or four individual fibres, and from the circumstance of the network being imbedded, in most cases, in the midst of fibrous tissue, it is very difficult to describe its exact relations and disposition. However, from the connexions of this network with the nerve-fibres, it would seem to follow that an impression made upon a given portion of a sentient surface might be transmitted to the nervous centre by contiguous fibres, as well as by the one which would form, so to say, the shortest route; and it is possible that impulses to motion may be conveyed to muscular fibres by a more or less circuitous path, as well as by a direct one.

Of the so-called tubular membrane.—This is a transparent structure in which the nerve-fibres are imbedded. It cannot strictly be called a membrane, because in many cases several fibres are imbedded in it, and often it is much thicker than the fibres it contains.

By examination with high powers (700 diameters), many fibres which appear to be single when seen by lower powers can be resolved into three or more, all enclosed in the same transparent tissue. As the nerve-fibres approach their distribution, this transparent structure becomes much spread out. It is intimately connected with nerve-fibres and capillaries, and with them forms a delicate expansion over the muscular fibres and in other parts; delicate fibres also, in connexion with the nerves and capillaries, may be observed in it. In some cases this expansion seems to be incorporated with the sarcolemma, and it is probable that in certain instances it is really the structure which has received that name.

Axis cylinder and white substance.—The author has been led to conclude that, in consequence of the free division of the axis cylinder and white substance near the point of distribution of the nerve, a single fibre in the trunk of a nerve may carry impressions to or from a much larger extent of surface than is generally supposed. The white substance which surrounds the axis cylinder gradually diminishes, until, in the finer ramifications, it is impossible to say that a fibre consists of an axis cylinder and white substance; for its general appearance and refractive power are the same in every part, except where the nuclei are situated. The author considers that the definite characters of the axis cylinder and white substance in the trunks of the nerve, may be due to the gradual growth and altered relations of the fibres which occur during the development of the entire organism. In the ultimate ramifications the whole fibre seems to consist of a very transparent and perhaps delicately granular substance, but no *tubular membrane, medullary sheath, or axis cylinder* can be demonstrated as distinct structures.

Of the formation of new fibres.—In connexion with the terminal ramifications, new fibres are being continually developed by the division of the nuclei, and old ones undergo removal. The remains of the latter may, however, be seen in the form of very delicate fibres, in connexion with active nerve-fibres. The author regards much of the so-called connective tissue between the elementary fibres of muscle and in some other situations, as of this nature,—as the remains of structures whose period of functional activity was past, and which have been removed, all but this small quantity of insoluble material.

The method of preparing the specimens is then briefly described. Observations were conducted principally on white mice, which were injected with the author's prussian blue fluid immediately after death *. The paper concludes with the following summary of the most important facts elucidated in the inquiry :—

1. That nerve-fibres in muscle and in many other tissues, if not in all, may be traced into, and are directly continuous with, a network formed of oval nuclei and intermediate fibres.

2. That the organs by which nerves are brought into relation with other textures, and the agents concerned in the development of nerves and the formation of new fibres, are the little oval bodies or nuclei which are present in considerable number in the terminal ramifications of all nerves. A great number of these bodies is associated with exalted nervous action, while, when they are sparingly found, we may infer that the nervous phenomena are only imperfectly manifested.

3. That every elementary fibre of striped muscle is abundantly supplied with nerves, and that the fibres of some muscles receive a much larger supply than others.

4. That the nerves lie, with the capillaries, external to, but in close contact with, the sarcolemma. They often cross the muscular fibre at right angles, so that one nerve-fibre may influence a great number of elementary muscular fibres. There is no evidence of their penetrating into the interior of the fibre.

The paper is illustrated with drawings, most of them magnified 700 diameters.

VII. "On the Effects produced by Freezing on the Physiological Properties of Muscles." By Michael Foster, B.A., M.D. Lond. Communicated by Dr. Sharpey, Sec. R.S. Received June 4, 1860.

The influence of cold upon animal life has been studied chiefly (as for example in reference to the phenomena of hybernation) at such degrees of temperature only as are insufficient to freeze the tissues. In cases of actual freezing, attention seems for the most part to have

* The Microscope in its Application to practical Medicine, p. 63.